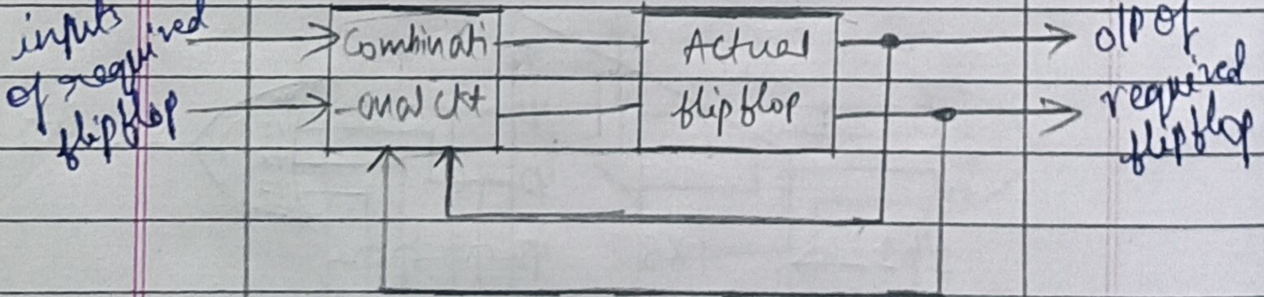
FLIP-FLOP CONVERSIONS

→ Converting one flip-flop into another flip-flop by adding some additional logic to the available flip flop.

→ Steps for flipflop conversion :-

1. Determine the required flip flop
2. Draw the truth table of required flip flop.
3. With the help of excitation table of the available flipflop, determine the inputs to be applied for obtaining the required output.
4. Get the expressions of the input using K-Maps.
5. Implement the circuit by connecting the addition logic to the available flip flop.



1. SR flipflop to other flipflops

(1) SR to JK flipflop

→ The required flipflop is JK flip flop.

→

J	K	Q_n	Q_{n+1}	S	R
0	0	0	0	0	X
0	0	1	1	X	0
0	1	0	0	0	X
0	1	1	0	0	1
1	0	0	1	1	0
1	0	1	1	X	0
1	1	0	1	1	0
1	1	1	0	0	1

→ K-Maps

S:-

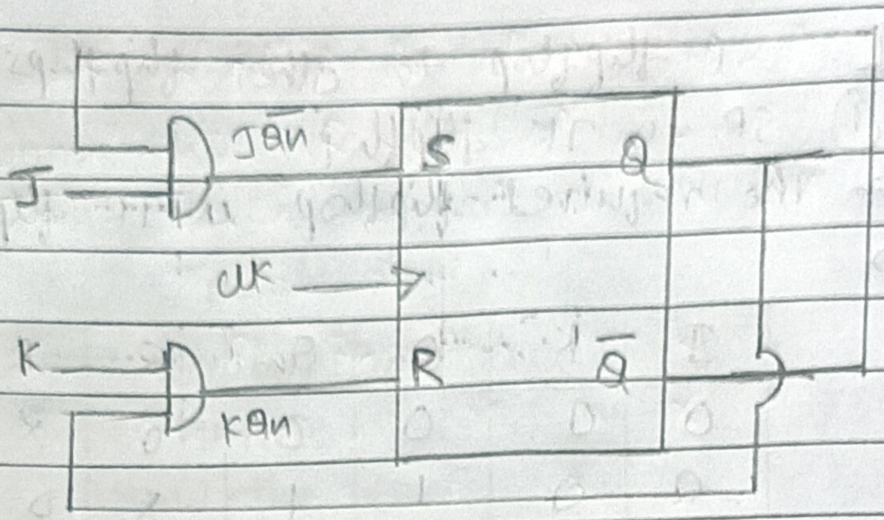
J \ KQ_n	00	01	11	10
0		X		
1	$\boxed{1}$	X		$\boxed{1}$

$S = J\overline{Q_n}$

R:-

J \ KQ_n	00	01	11	10
0	X		1	X
1			1	

$R = KQ_n$



SR to JK flip flop

② SR to D flip flop

→ The required flip flop is D - flip flop

→

D	Q_n	Q_{n+1}	S	R
0	0	0	0	X
0	1	0	0	1
1	0	1	1	0
1	1	1	X	0

→ K-Maps

S:-

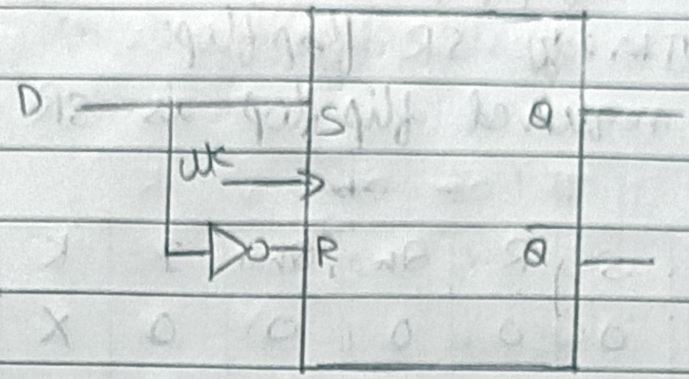
D \ Q_n	0	1
0		
1	1	X

$S = D$

R:-

D \ Q_n	0	1
0	X	1
1		

$R = \bar{D}$



SR to D-flipflop

③ SR to T flipflop

→ the required flipflop is T-flipflop

→

T	Q_n	Q_{n+1}	S	R
0	0	0	0	X
0	1	1	X	0
1	0	1	1	0
1	1	0	0	1

→ K-Maps:-

S:-

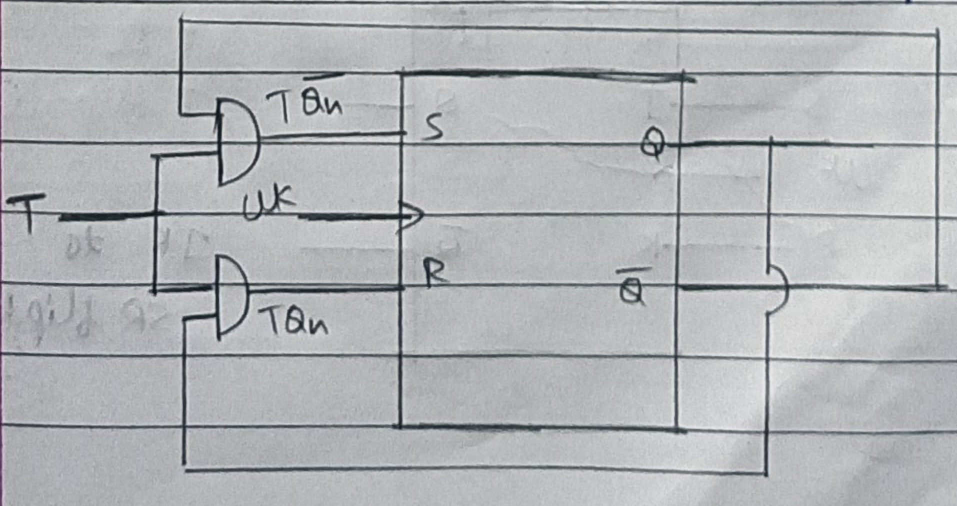
$T \backslash Q_n$	0	1
0		X
1	$\boxed{1}$	

$S = T\overline{Q_n}$

R:-

$T \backslash Q_n$	0	1
0	X	
1		$\boxed{1}$

$R = TQ_n$



SR to T-flipflop

2. JK flipflop to other flipflops

① JK to SR flipflop

→ The required flip flop is SR flip flop

→

S	R	Q_n	Q_{n+1}	J	K
0	0	0	0	0	X
0	0	1	1	X	0
0	1	0	0	0	X
0	1	1	0	X	1
1	0	0	1	1	X
1	0	1	1	X	0
1	1	0	X	X	X
1	1	1	X	X	X

→ K-Maps

J's

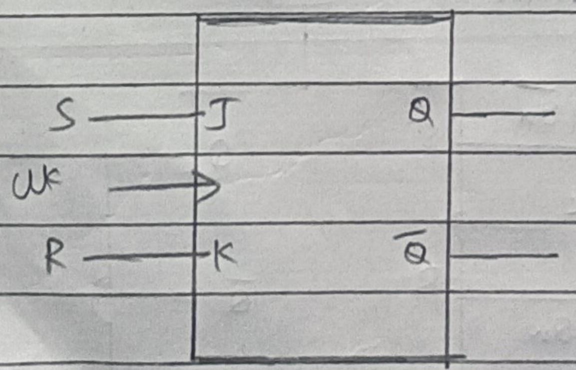
S \ RQ_n	00	01	11	10
0	0	X	X	
1	1	X	X	X

J = S

K's

S \ RQ_n	00	01	11	10
0	X		1	X
1	X		X	X

K = R



JK to SR flipflop

② JK to D flipflop:-

→ the required flip flop is D flip flop

→

D	Q_n	Q_{n+1}	J	K
0	0	0	0	X
0	1	0	X	1
1	0	1	1	X
1	1	1	X	0

→ K-Maps

J:-

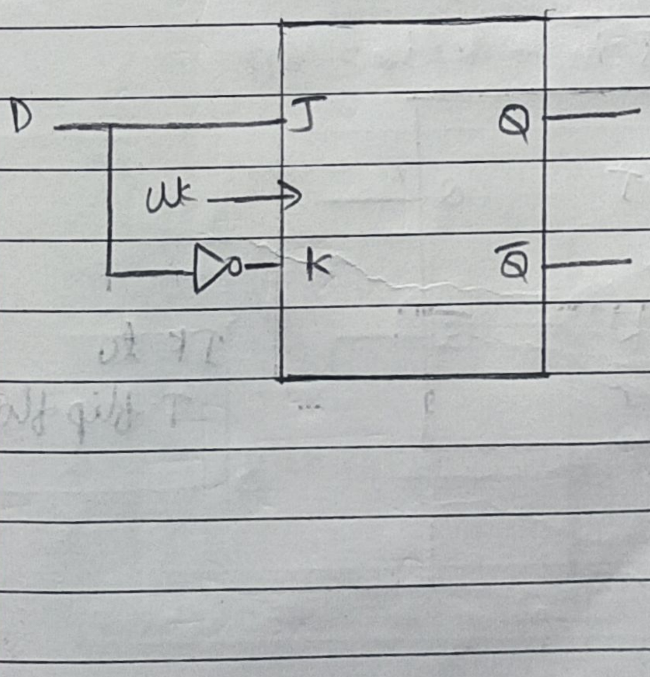
D \ Q_n	0	1
0		X
1	1	X

$J = D$

K:-

D \ Q_n	0	1
0	X	1
1	X	

$K = \overline{D}$



JK as D flipflop

③ JK to T flipflop

→ the required flip flop is T flip flop

→

T	Q_n	Q_{n+1}	J	K
0	0	0	0	X
0	1	1	X	0
1	0	1	1	X
1	1	0	X	1

→ K-Maps

J:-

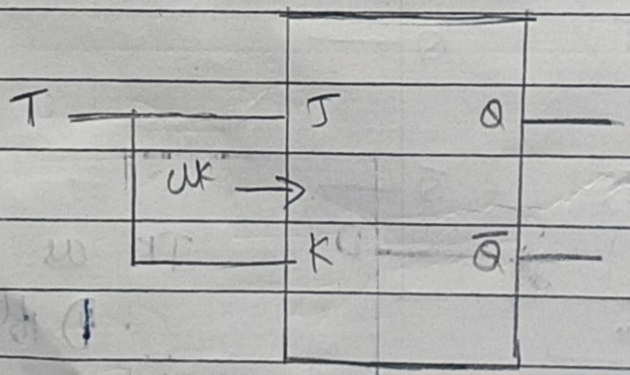
T \ Q^n	0	1
0		X
1	1	X

$J = T$

K:-

T \ Q^n	0	1
0	X	
1	X	1

$K = T$



JK to T flip flop

3. D flip flop to other flipflops

① D to SR flipflop

→ the required flipflop is SR flipflop

→

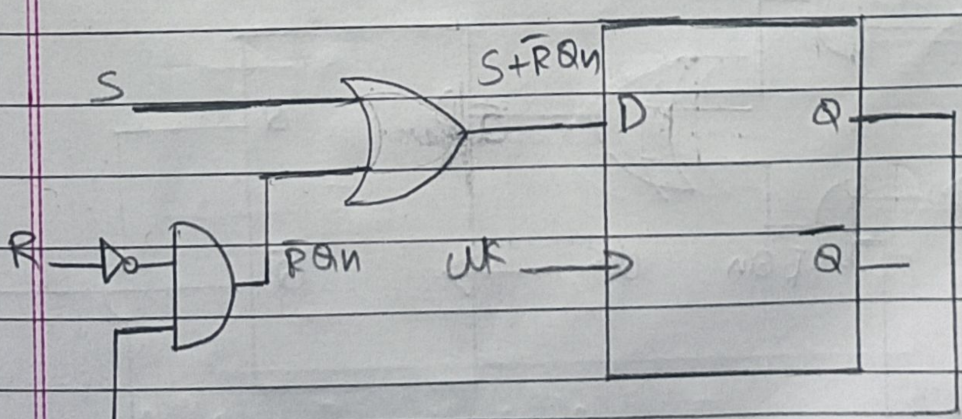
S	R	Q_n	Q_{n+1}	D
0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	0	0
1	0	0	1	1
1	0	1	1	1
1	1	0	x	x
1	1	1	x	x

→ K-Map

D :

S \ R Q_n	00	01	11	10
0		1		
1	1	1	x	x

$D = S + \bar{R}Q_n$



D to SR flipflop

② D to JK flipflop

→ the required flipflop is JK flip flop

→

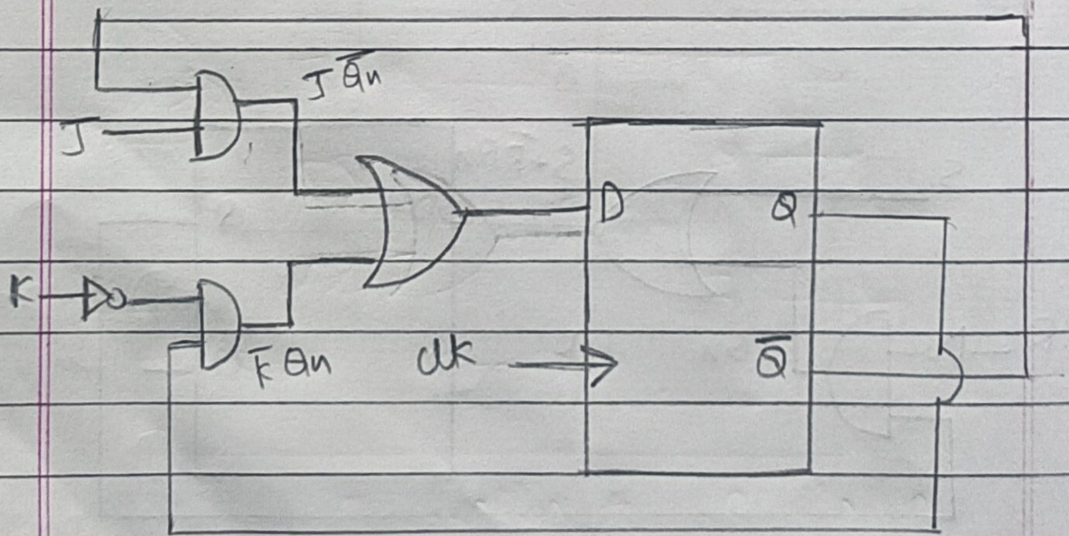
J	K	Q_n	Q_{n+1}	D
0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	0	0
1	0	0	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	0	0

→ K-Map

D:-

J \ KQ_n	00	01	11	10
0		1		
1	1	1		1

$$D = J\bar{Q}_n + \bar{K}Q_n$$



③ D to T flip flop

→ the required flipflop is T flipflop

→

T	Q_n	Q_{n+1}	D
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	0

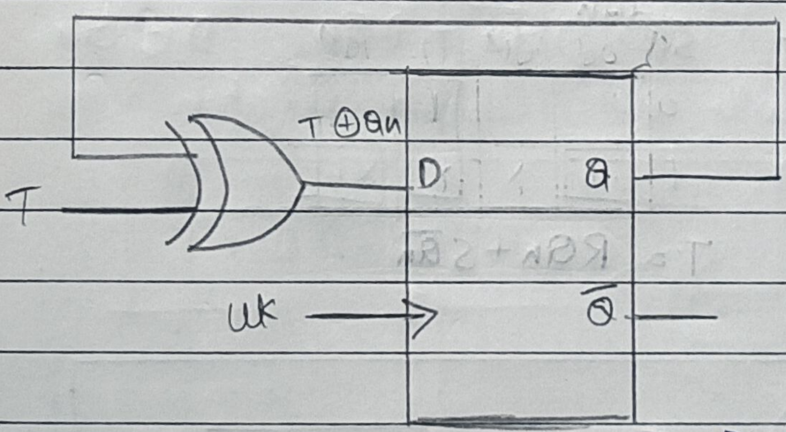
→ K-Map

D :-

T \ Q_n	0	1
0		1
1	1	

$$D = T\overline{Q_n} + \overline{T}Q_n$$

$$D = T \oplus Q_n$$



D to T flipflop

4. T flipflop to other flipflops

(1) T to SR flipflip

→ the required flipflop is SR flipflop

→

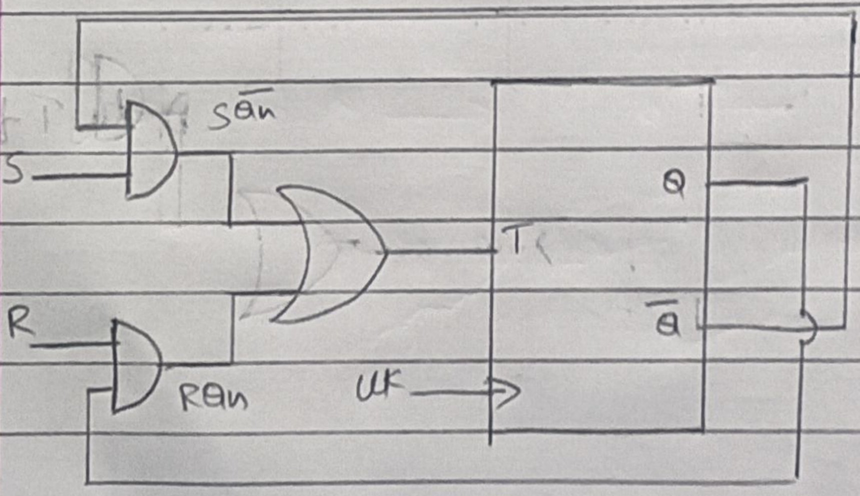
S	R	Q_n	Q_{n+1}	T
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	0	1
1	0	0	1	1
1	0	1	1	0
1	1	0	x	x
1	1	1	x	x

→ K-Map

T:

S \ RQ_n	00	01	11	10
0			1	
1	1		X	X

$T = RQ_n + S\overline{Q_n}$



T flipflop to SR flipflop

(2) T to JK flip flop:-

→ the required flipflop is JK flipflop.

→

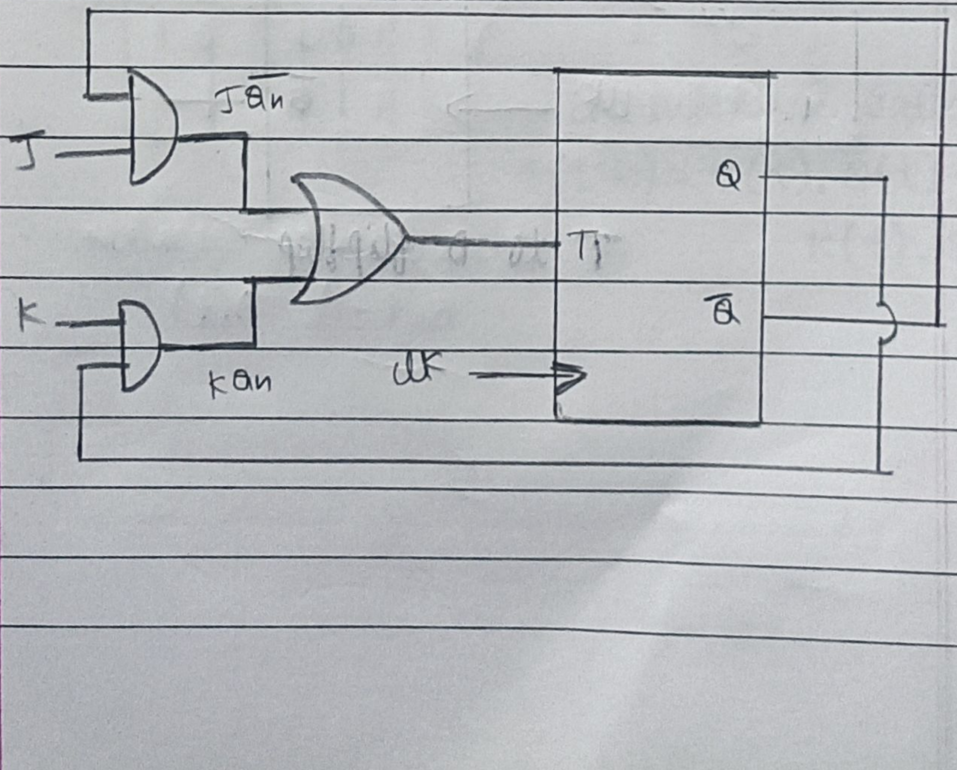
J	K	Q_n	Q_{n+1}	T
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	0	1
1	0	0	1	1
1	0	1	1	0
1	1	0	1	1
1	1	1	0	1

→ K-Map

T :-

J \ KQ_n	00	01	11	10
0			1	
1	1		1	1

$$T = J\bar{Q}_n + KQ_n$$



③ T to d flip flop

→ The required flipflop is D flipflop

→

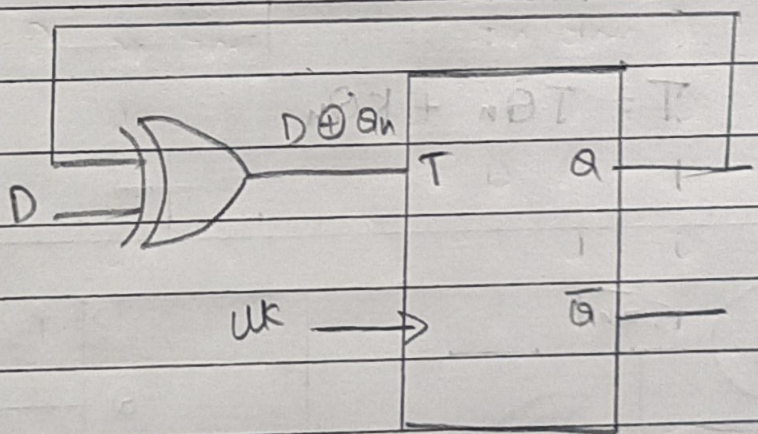
D	Q_n	Q_{n+1}	T
0	0	0	0
0	1	0	1
1	0	1	1
1	1	1	0

→ K-Map

T :

D \ Q_n	0	1
0		1
1	1	

$$T = D\overline{Q_n} + \overline{D}Q_n = D \oplus Q_n$$



T to D flipflop

* TRUTH TABLE Vs EXCITATION TABLE

→ Truth table gives the information about the output for a specific combination of input signals.

→ Excitation table gives the information about the set of inputs to be applied for getting a specific output. Excitation table will be very helpful for designing sequential circuits.

① JK Flipflop:-

→ Truth Table:-

J	K	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

→ Excitation Table:-

Q_n	Q_{n+1}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Characteristic equation:-

$$Q(t+1) = J(t).\bar{Q}(t) + \bar{K}(t).Q(t)$$

② SR flipflop

→ Truth Table

S	R	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	X
1	1	1	x

→ Exitation Table

Q_n	Q_{n+1}	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

characteristic equation

$$Q(t+1) = Q(t) . R(t) + S(t)$$

③ D Flipflop

→ Truth Table

D	Q_n	Q_{n+1}
0	0	0
0	1	0
1	0	1
1	1	1

→ Exitation Table

Q_n	Q_{n+1}	D
0	0	0
0	1	1
1	0	0
1	1	1

characteristic equation:-

$$Q(t+1) = D(t)$$

(4) T- flipflop

→ Truth Table

T	Q_n	Q_{n+1}
0	0	0
0	1	1
1	0	1
1	1	0

→ Excitation Table

Q_n	Q_{n+1}	T
0	0	0
0	1	1
1	0	1
1	1	0

characteristic equation:-

$$Q(t+1) = Q(t) \wedge T(t)$$